Using Market Information to Help Identify Distressed Institutions: A Regulatory Perspective

*Timothy J. Curry, Peter J. Elmer, and Gary S. Fissel**

In recent years the call for incorporating market signals into bank supervision has spread from academic circles to U.S. bank regulators, Congress, and international regulatory bodies.[1] Donna Tanoue, Chairman of the Federal Deposit Insurance Corporation (FDIC) from 1998 to 2001, Alan Greenspan, Chairman of the Federal Reserve System, and other Federal Reserve Governors have commented on the importance of harnessing market forces to help with supervisory monitoring and to encourage market discipline.[2] The Basel Committee on Bank Supervision, which establishes capital standards for international banks, recently proposed using market forces as one of its "three key pillars" of comprehensive capital-adequacy regulations.[3]

Interest in the use of market information arises from the ability of financial markets to interpret public information very quickly. Even though bank supervisors have an advantage over the market owing to their access to extensive private information from on-site bank examinations, these examinations occur only after relatively long intervals, usually every 12 to 18 months, and

* Timothy Curry and Gary Fissel are senior financial economists in the Division of Insurance and Research of the Federal Deposit Insurance Corporation (FDIC). Peter Elmer was a senior economist in the FDIC's Division of Research and Statistics when this work was being conducted. The authors would like to thank John O'Keefe, Daniel Nuxoll, Gerald Hanweck, and Richard Bogue for helpful comments, and Audrey Clement and Justin Combs for extensive research assistance.

[1] This note focuses on the academic literature. Flannery (1998) summarizes this literature through the late 1990s. More recently, Berger and Davies (1998) use event-study methodology to find that the equity market anticipates upgrades in regulatory ratings but follows downgrades. Berger, Davies, and Flannery (2000) find that regulators acquire information sooner than the equity markets and bond rating agencies do, but the regulatory assessments are generally less accurate than either stock or bond market indicators in predicting the future performance of bank holding companies. Elmer and Fissel (2000) find that equity market variables can be used to augment accounting-related information to predict bank failure. Krainer and Lopez (2001) find that equity market variables such as stock returns and equity-based default frequencies are useful to bank regulators for assessing the condition of bank holding companies. Gunther, Levonian, and Moore (2001) find that a measure of financial viability based on stock prices (expected default frequency) helps predict the financial condition of bank holding companies as reflected in their supervisory ratings. Curry, Elmer, and Fissel (2001) find that incorporating market data into traditional off-site monitoring models helps identify downgraded and upgraded banks and thrifts that were not affiliated with multibank holding companies. Curry, Fissel and Hanweck (2003) find that market-indicator variables add value to models in predicting bank holding company supervisory ratings.

[2] Tanoue (2001); Greenspan (1998); Meyer (1998). The term *market discipline* generally refers to the ability of the market to price or impose costs on institutions based on their risk. The costs, for example, might take the form of higher issuance costs in the bond markets and/or lower equity prices.

[3] The three pillars include minimum capital requirements, supervisory review and market discipline.

may quickly become outdated.[4] As for off-site reviews, they depend on quarterly accounting data that may not be audited or may not reflect the changing risk profile of the institution. However, these same quarterly accounting data are widely available to the public and therefore are used by financial markets as well as regulators to assess risk. If financial markets can process and interpret this public information more efficiently than bank regulators, market prices might either complement or supplement the off-site and/or on-site monitoring systems used by the regulators.

Studies that have examined the potential use of market signals in bank supervision have focused primarily on the debt market for signs of changing risk patterns in insured institutions. This focus has been popular because the concerns of investors in these markets, particularly subordinated-debt investors, are closely aligned with the concerns of bank supervisors. Equity markets, however, should provide as much information as debt markets because equity investors are the first to lose if a bank experiences problems.[5] Moreover, the number of banking institutions with publicly traded equity is much larger than the number of institutions with publicly traded subordinated debt, and trading volume tends to be much higher for equities than for subordinated debt.

The purpose of this article is to assess the relationship, in timing and magnitude, between equity market valuations of commercial banks and thrift institutions and changes in the supervisory ratings for these organizations. In particular, we ask two questions: to what extent do market variables such as stock prices, returns, and trading volume (among others) provide timely market signals? And if they do provide timely signals, can they add incremental value to off-site monitoring systems that attempt to predict changes in the CAMEL ratings assigned by regulators?[6] We begin to address these questions by discussing the institutional setting for the downgrading of a bank's CAMEL rating. We then evaluate problems associated with interpreting market data before examination ratings are changed. Finally, we perform statistical tests to test the incremental predictive content of market-related variables compared with accounting data from bank financial reports.

The Institutional Setting

Modern bank supervision uses information gathered from on- and off-site supervisory tools as the starting point for its analysis. The larger banks and bank holding companies are monitored by on- and off-site inspectors (examiners), who keep abreast of any information that can be found, including news reports, Wall Street analyses, and traditional quarterly financial data.[7] Most smaller and midsized banks are initially monitored with automated analysis of quarterly financial statements and then, if risk is identified, are reviewed by analysts in addition to regular on-site examinations.

Periodic on-site safety-and-soundness examinations begin with off-site pre-exam reviews of quarterly and other pertinent data. This information is then checked in on-site reviews, which also explore issues that might not be revealed in the quarterly reports. In fact, on-site examinations provide extensive financial information that is not generally available to the public, such as the current status of performing and nonperforming

[4] Federal law mandates that all federally insured banking institutions be examined at least every 12 to 18 months, depending on the size and condition of the institution. Weaker institutions are often subject to more frequent scrutiny. For evidence that bank examinations may age quickly, see Cole and Gunther (1998).

[5] Levonian (2001) has shown that equity market information and debt market information should produce similar results.

[6] The acronym "CAMEL" stands for **C**apital, **A**ssets, **M**anagement, **E**arnings, and **L**iquidity, five components of a bank's financial operation that are examined by the regulators. In the late 1990s a sixth component was added to the CAMEL rating system, recognizing bank and thrift Sensitivity to interest-rate or market risk (CAMELS). CAMELS ratings are assigned on a scale of 1 to 5 with 1 being the highest and 5 the lowest. Because the empirical portions of our analysis relate to ratings assigned before the late 1990s, we reference the five-component rating system in effect at that time.

[7] It should be noted that for the largest U.S. banks, in recent years the Comptroller of the Currency and other regulators (including the FDIC) have established supervisory programs with continuous on-site presence.

loans, loan classifications and the adequacy of loan-loss provisions, and bank capital; on-site examinations also provide a close-up view of managerial abilities and expertise.

At the end of on-site examinations, bank inspectors assign an overall, or composite, CAMEL rating (see note 6); these ratings range from 1 to 5. Ratings of 1 or 2 are assigned to institutions in fundamentally sound financial condition. When a previously 1- or 2-rated bank is downgraded to 3, an important signal of supervisory concern is sent and is normally accompanied by an understanding between the bank's primary regulator and senior bank management specifying the nature of the bank's weakness and procedures for changing bank policies to rectify the perceived problems. These understandings are classified by regulators as "informal" enforcement actions because they are not administratively or judicially enforceable in a court of law in the event of noncompliance.[8] Nevertheless, such actions represent a loud "shot across the bow" signaling significant regulatory concern and the need for change. Institutions downgraded to a 3 will typically retain that rating for periods ranging from six months to several years before being assigned a higher or lower rating.

Downgrading a bank's CAMEL rating to 4 or 5 indicates the existence of serious problems that, if not resolved, present a distinct possibility of insolvency. In practice, the term "problem" bank is often reserved for institutions with a composite rating of 4 or 5, and regulatory "problem-bank lists" tend to specify institutions with these ratings, although practices vary. Banks downgraded to 4 typically require immediate remedial actions and intensive monitoring by regulatory officials. In some cases, bank supervisory officials may opt not to choose the more serious "formal" enforcement actions for 4-rated banks as long as bank management addresses regulatory concerns.

[8] Informal enforcement actions may require institutions to make changes, such as raising new equity capital, limiting the origination of certain types of loans, or increasing loan-loss reserves. Although regulators vary in their practices, the most common type of informal action accompanying a downgrade to 3 is a "memorandum of understanding" (MOU), which is written by bank supervisors and signed by bank officials and supervisors.

However, consistent with supervisory policy, most banks downgraded to a 4 or 5 are subject to formal enforcement actions, and these actions have been made public since 1989.[9] Institutions with a CAMEL rating of 4 can continue in business for as long as several years before either returning to an improved rating, moving to a worse rating, or being declared insolvent by their primary regulator. A rating of 5 indicates a high probability of failure, usually within the next 12 months.

Interpreting Market Signals

If information embedded in market prices is to be integrated into the off-site monitoring process, the message contained in the information must be clear and timely and must add incremental predictive value to other sources of information commonly used by off-site monitoring, such as the quarterly financial data. If these characteristics are lacking, the value of the information declines either because its interpretation is vague or because it fails to improve existing supervisory practices.

The interpretability and practical usefulness of market information are keys to integrating it into off-site monitoring. (Here we discuss interpretation; in the remaining sections of the article we discuss usefulness.) Market prices are notorious for their wide fluctuations over short periods of time, and interpreting the information contained in prices that repeatedly jump upward and downward may be difficult. Although short-term fluctuations would be reduced if the focus were on longer-term price and return trends, the choice of a time period to use for these types of analyses is subjective, and smoothing trends over longer periods reduces the timeliness of the information.

Interpretation issues aside, the use of market data would open the door to a substantial list of variables that might be helpful in bank analysis. Two such variables are return volatility and trading

[9] The Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) mandated that formal enforcement actions become part of the public record.

volume. For example, Merton's (1973) option model expects a rise in return volatility as an institution approaches insolvency. Wang (1994) ties trading volume to the flow of information about a firm's financial health, suggesting that trading volume should rise as information about financial distress is released. Although a comprehensive analysis of market-related variables goes beyond the scope of this article, return volatility and trading volume represent two that are easily observed and that are expected by financial theory to contain predictive content.

In summary, although the interpretability of price and other market changes remains an issue, there are nevertheless compelling arguments for finding ways to integrate market data into the off-site monitoring process, and there are also a variety of market variables that might be used to this end. Therefore, debate about regulatory use of market-related information in prudential bank supervision should focus on empirical, not conceptual, issues. One particular empirical issue is whether market-related variables add incremental predictive value to quarterly accounting data or other information that is easily available to regulators in off-site monitoring systems. Unless market signals increase predictive value, they may be viewed as redundant information with little supervisory value.

The Sample

Our empirical analysis begins with a sample of publicly traded banks and thrifts whose ratings were downgraded to problematic levels between the first quarter of 1988 and the last quarter of 1995.[10] Since a CAMEL rating of 3 signifies significant regulatory concern but ratings of 4 and 5 signify more severe financial distress that is often followed by failure, we separate institutions downgraded to 3 from those downgraded to 4 or 5. Combining the 4s and 5s into a single group appeared reasonable inasmuch as institutions pass to failure from these two ratings fairly commonly, but do so from a rating of 3 or better only occasionally.

To improve the integrity of the analysis, we imposed several additional restrictions. The sample was limited to institutions that had a lengthy period of superior ratings before being downgraded. We implemented this condition by requiring that institutions have CAMEL ratings in the 1–2 range for at least two years before being downgraded to 3. Similarly, institutions downgraded to a 4 or 5 were required to have had ratings in the 1, 2, or 3 range for at least two years preceding downgrade to 4 or 5. The sample was also limited to banks and thrifts that either were not affiliated with bank holding companies or were members of bank holding companies that held only a single institution. Restricting the sample in this fashion ensured that the extensive financial data reported on bank quarterly reports corresponded closely to the institution that issued the stock. This restriction also reduced contamination from activities of nonbank subsidiaries of bank holding companies.[11] Since the empirical analysis combines quarterly financial data with stock market information reported by the Center for Research in

[10] The sample population was drawn from a universe of all banks and thrifts from 1988 to 1995 that were publicly traded, as reflected in the availability of stock price information from the Center for Research in Security Prices (CRSP). To obtain stock price information for individual commercial banks and thrifts, we matched CRSP data against bank quarterly reports going back to 1986. We then matched the firms against bank examination ratings to obtain the historical CAMEL ratings. Within the group for which all this information was available, we identified all institutions that were downgraded to a 3, 4, or 5 during our period. To form the sample in our study, we reduced this group by the additional restrictions discussed in the next paragraph of the text. The sample of CAMEL 1- or 2-rated, or "healthy," banks against which the downgraded groups were matched was also taken from this universe of publicly traded institutions (see note 14).

[11] Analysis of multibank holding company equity securities carries disadvantages (as well as advantages) compared with analysis of non-affiliated banks and thrifts and one-bank holding companies. For example, multibank holding companies tend to be large institutions that are widely traded and rated by nationally recognized rating agencies. Although one-bank holding companies and banks not affiliated with holding companies tend to have the opposite characteristics, their quarterly financial data nevertheless correspond directly to the institution that is publicly traded, and the quarterly financial data are far more extensive than financial data released at the holding-company level. Moreover, the many activities of holding company subsidiaries cannot be separated from the aggregated data reported at the holding-company level, and this lack of separability obscures the extensive information released by individual banks. Market signals at the holding-company level may or may not correspond to the performance of the bank subsidiary. The potential disconnect between the performance of individual banks and the market signals of their holding companies may widen as holding companies respond to passage of the Gramm-Leach-Bliley Act of 1999 by diversifying into additional nonbank activities.

Security Prices (CRSP), both sources of data were required for an institution to be included in the sample; in addition, historical CAMEL ratings over the period had to be available. For the logistic regressions, the downgraded banks in each of the two groups are paired against a sample of healthy banks (those rated a 1 or 2).

Table 1 provides summary statistics for the two groups of downgraded institutions. The sample size is relatively large for both groups, with 83 institutions downgraded to 3 and 107 downgraded to 4 or 5. Considerable diversity is apparent in the sample. For example, both groups of downgraded institutions include thrifts as well as banks, and both groups had a wide range of asset sizes, encompassing institutions with total assets under $100 million as well as institutions with assets over $5 billion. More than 75 percent of the institutions had assets under $1 billion, while slightly less than 20 percent had assets in the $1–5 billion range and about 5 percent were in the over-$5 billion range. The relatively healthier condition of institutions downgraded to 3 is reflected in their higher book equity-to-assets and return-on-assets ratios compared with the ratios reported for institutions downgraded to 4 or 5. Stronger financial health appears to be recognized by the market, as reflected in a more favorable book-to-market equity ratio for institutions downgraded to 3, compared with the ratio for those downgraded to 4 or 5.

Univariate Trends Preceding Downgrades

Table 2 displays univariate characteristics of stock prices, returns, and other market-related variables for banks and thrifts during the eight quarters preceding the institutions' downgrades to CAMEL rating 3, 4, or 5.[12] The sample varies slightly from quarter to quarter because the delisting rules of various exchanges (rules such as minimums for capital requirements and trading activity) reduce the availability of stock price information for individual firms.

[12] Examinations that lead to rating downgrades can last from several weeks to a month or more, depending on the severity of the case. They conclude with a notification to management that the institution's rating will be downgraded. Thus, the zero quarter can be regarded as contemporaneous with the notification quarter or the quarter of the rating change.

Table 1

Summary Statistics for Sample of Downgraded Institutions

	A. At Time of Downgrade to 3				B. At Time of Downgrade to 4 or 5			
	No.	Minimum	Median	Maximum	No.	Minimum	Median	Maximum
Call Report Financial Data								
Total Assets ($000s)	83	36,647	40,381	9,375,411	107	20,316	381,583	15,469,836
Book Equity/Asset Ratio (%)	83	4.82	7.37	96.98	107	0.00	6.02	16.50
Return on Assets (%)	83	–7.71	0.40	2.27	107	–16.75	–1.03	1.20
CRSP Market Data								
Market Price ($ per share)	83	0.74	7.96	36.25	107	0.53	5.23	16.87
Market Capitalization ($000s)	83	2,523	21,434	656,355	107	444	14,700	453,148
Book/Market Equity Ratio	83	0.09	1.45	10.60	107	0.02	1.58	9.04
Total Sample	83				107			
Number with Assets <$1 Billion	64				79			
Number with Assets $1–5 Billion	16				19			
Number with Assets >$5 Billion	3				9			
Number of Banks	77				99			
Number of Thrifts	6				8			

Note: The data are from quarterly financial data reported to regulators or are derived from CRSP during the quarter in which the CAMEL rating of the institution was downgraded. Market capitalization equals equity price times number of shares at the end of the quarter of the downgrade.

Table 2

Characteristics of Stock Price, Return, and Other Market Variables by Quarter Preceding Downgrade in CAMEL Rating

Qtrs to Rating Change	Sample	Avg. Stock Price (dollars)	Change in Stock Price (dollars)	Cum. Qtrly. Return (percent)	CRSP Equal Wt. Excess Return (percent)	CRSP Value Wt. Excess Return (percent)	Industry Value Wt. Excess Return (percent)	Std. Dev. Daily Return (percent)	Change in Std. Dev. Daily Return (percent)	Avg. Daily Trading Volume (shares)	Avg. Qtrly Turnover Ratio (percent)
A. Trends Preceding Downgrade to 3											
–8	79	15.42	0.16 0.53	2.95 1.51	–4.10 –2.47**	–1.55 –0.96	–1.55 –0.91	2.63	–0.02 9.93***	10,449	13.52
–7	83	14.66	–0.78 –1.88*	–0.83 –0.50	–6.08 –3.81***	–4.58 –2.89***	–4.58 –2.85***	2.59	–0.07 –0.70	10,077	13.29
–6	83	13.64	–1.04 –2.76***	–2.40 –1.42	–7.01 –4.62***	–5.98 –3.98***	–5.49 –3.54***	2.55	0.00 –0.08	9,595	13.65
–5	84	12.98	–0.77 –1.37	–0.88 –0.44	–4.79 –3.04***	–3.86 –2.30**	–2.61 –1.65*	2.79	0.25 2.23***	10,660	13.39
–4	84	12.32	–0.66 –2.99***	0.45 0.24	–6.88 –4.51***	–3.68 –2.02**	–4.24 –2.23**	2.82	0.00 0.26	10,646	12.50
–3	84	11.78	–0.54 –2.92***	–0.04 –1.94*	–8.74 –5.63***	–7.08 –4.23***	–6.06 –3.73***	2.97	0.15 1.20	11,991	13.89
–2	83	11.34	–0.50 –2.82***	–3.77 –1.47	–7.05 –3.33***	–5.02 –2.20**	–3.57 –1.68*	3.54	0.55 4.75***	12,372	14.87
–1	83	10.52	–0.82 –3.55***	–2.73 –1.15	–9.08 –4.84***	–6.15 –2.91***	–6.71 –3.59***	4.05	0.51 2.88***	12,023	15.12
0	83	9.91	–0.56 –2.36**	–1.69 –0.65	–11.16 –5.24***	–5.43 –2.19**	–7.37 –2.99	4.01	–0.06 –0.32	12,625	15.52
B. Trends Preceding Downgrade to 4 or 5											
–8	105	12.20	0.15 0.30	0.46 0.25	–3.60 –2.40**	–2.74 –1.71*	–1.51 –1.00	2.92	–0.14 –0.81	14,908	15.19
–7	107	11.76	–0.32 –1.68*	–4.87 –2.90***	–7.66 –5.05***	–7.41 –4.76***	–5.58 –3.48***	3.06	0.20 1.68*	13,620	14.06
–6	107	11.09	–0.66 –2.02**	–3.32 –1.72*	–8.50 –5.39***	–7.44 –4.33***	–6.84 –4.32***	3.08	–0.03 –0.23	13,196	13.75
–5	109	10.26	–0.69 –5.39***	–5.89 –3.59***	–11.17 –7.32***	–9.60 –6.57***	–8.79 –5.73***	3.45	0.23 1.72*	12,130	12.94
–4	110	9.83	–0.34 –1.87*	–6.52 –3.05***	–11.87 –6.41***	–10.51 –5.39***	–10.42 –5.59***	3.53	0.36 2.52***	12,400	13.35
–3	108	9.19	–0.75 –3.07***	–5.32 –1.97**	–9.98 –4.32***	–8.49 –3.40***	–7.02 –3.00***	4.08	–0.10 –0.15	14,619	13.94
–2	107	8.14	–1.03 –5.80***	–9.89 –4.53***	–15.72 –8.39***	–12.59 –5.90***	–12.83 –6.14***	4.89	0.58 3.23***	13,424	12.67
–1	107	6.94	–1.20 –6.28***	–5.89 –1.59	–12.80 –4.06***	–9.04 –2.56**	–9.48 –2.90**	5.79	0.48 2.05**	14,739	13.45
0	107	5.97	–0.97 –5.48***	–9.68 –2.63***	–15.52 –4.85***	–11.42 –3.28***	–12.42 –3.83***	5.87	0.61 2.43**	15,506	13.61

Note: The data reported on each of the quarter-to-quarter rating change lines (–8 to 0) are calculated as simple averages for all trading days in each quarter. If the data required for any quarterly calculation are missing, they are omitted from the calculation. Excess returns are calculated as the difference between the cumulative quarterly return of each stock and the cumulative quarterly return of the various indices. *T*-statistics testing the hypothesis that the mean equals zero are shown below many of the quarterly average return and change-in-return statistics. A single, double, or triple "*" indicates significance at the 10 percent, 5 percent, or 1 percent level, respectively.

The data show quarterly average stock prices falling continually throughout the eight quarters before the downgrades. As expected, the decline in stock prices is more precipitous for the more distressed group—the 4- and 5-rated institutions. To examine the consistency of changes in stock prices across the sample, we used a t-test to test the hypothesis that the mean change of each quarterly sample equals zero. For the 3-rated group, this test shows that the decline in stock price is consistently statistically significant beginning in the fourth quarter preceding the downgrade. For the 4- or 5-rated group, the change is significant seven quarters before the downgrade, reflecting the more distressed nature of this group. The t-test results suggest that a simple test can be used to identify declining stock prices that might precede a drop in an institution's CAMEL rating.

The steady decline in quarterly prices preceding a downgrade causes persistent patterns of negative cumulative quarterly returns as well.[13] Quarterly returns are negative preceding downgrades for both groups under consideration, although the t-tests are not as conclusive as they are for declining prices. For institutions downgraded to CAMEL 3, the negative returns are not significantly distinguishable from zero preceding the downgrade, although institutions downgraded to 4 or 5 have significant negative returns in most quarters preceding their rating change.

Patterns of negative returns are more easily seen if one calculates the differences between quarterly stock returns and the quarterly returns for either of several indices of market performance. Using three indices of market returns (the CRSP equal-weighted and value-weighted indices and an industry value-weighted index constructed from bank and thrift institutions), table 2 shows that market excess returns are generally negative and statistically significant during the eight quarters preceding a downgrade, regardless of the market index used as a benchmark. These results hold for the 3-rated group as well as the 4- or 5-rated group. The consistency of the t-test results again supports the notion that simple tests might be used to identify problematic institutions, while reaffirming Pettway's (1980) finding of negative excess returns for lengthy periods preceding financial distress.

Consistent with financial theory, a measure of return volatility—the standard deviation of daily returns—tends to rise as the time of downgrade approaches. That is, the volatility variable rises steadily for both groups as the downgrades approach, especially during the four quarters immediately preceding the downgrades. Volatility is noticeably higher for the most distressed institutions (CAMEL 4 or 5) than for the moderately distressed institutions (CAMEL 3). The statistical significance of the rising volatilities is confirmed with significant t-statistics for two quarters preceding a downgrade, but these patterns are not consistently found in earlier periods preceding a downgrade.

Two measures of trading activity are used to examine the hypothesis that trading increases as distress approaches. These variables, however, generally fail to follow the rising trend preceding downgrade (financial theory expected otherwise). The most direct measure of trading activity—average daily trading volume for the quarter—increases slightly before the downgrades for the 3-rated group but fails to follow a consistent trend for the 4- or 5-rated group. A second measure of trading activity, known as *turnover*, divides the shares traded in any quarter by total shares outstanding at the end of each quarter. The turnover variable also increases slightly before downgrades to 3 but not before downgrades to 4 or 5. Therefore, the trading activity variables appear to contain very little informational content before CAMEL rating downgrades.

[13] The cumulative quarterly return is calculated by multiplying unity plus the daily return for each stock i on day t$(1+r_{it})$ across all trading days in each quarter, then subtracting unity.

Incorporating Market Information into Supervisory Models

Testing the incremental importance of stock price, return, and other market variables against the traditional financial variables contained in the quarterly reports allows us to formally distinguish the marginal predictive value of the two types of explanatory variables. This approach proceeds by initially specifying a traditional, or ratio-based, CAMEL rating prediction model, then extending the model to include market-related variables. Although the market variables need not dominate the traditional ratio-based model, a minimum level of competency is required to justify a conclusion that market-related information provides a meaningful addition to the traditional analysis. For example, if the market has a unique ability to interpret quarterly financial data, then market variables should provide statistically significant explanatory power to models that predict rating downgrades on the basis of traditional financial ratios.

In this section, a binomial logistic model is estimated to explain changes in financial institution supervisory (CAMEL) ratings. The binary dependent variable (CAMELCAT) in the equation takes a value of "1" if the institution is downgraded to the 3, 4, or 5 level over the 1988–1995 period, and a "0" if the institution remains a healthy 1- or 2-rated institution.[14] The logistic regression estimates the likelihood that a bank or thrift will be downgraded. Table 3 defines the variables used in the regression model for the downgraded and control groups, along with their means and standard deviations. The regressions are run four quarters (one year) before the quarter of the downgrade. Since bank regulators generally release financial data one to two months after the end of each quarter, the quarterly financial data in the regressions are measured five quarters before the downgrade quarter, whereas the data from the market variables are measured four quarters before the downgrade quarter.

Several control variables are used to account for factors that might influence the likelihood of a downgrade. The first variable (BK_SIZE) controls for differences in institution size and is measured as a dummy variable, with a value of "1" for institutions greater than $1 billion and "0" otherwise. To the extent that firm size provides greater opportunities for diversification and access to capital markets, a negative relationship between the probability of a downgrade and institution size is expected. A second control variable (STATE) accounts for differences in economic conditions over the period of this study among the states and regions from which the sample was drawn. The STATE variable is defined as measuring the quarterly percentage change in requests for housing permits. A negative sign is expected between the STATE variable and the probability of being downgraded.

A regulatory variable is specified in the model to account for differences in the amount of private as opposed to public information available at the time of the downgrades. Bank supervisory officials have access to considerable amounts of private information about the financial condition of their regulated institutions: confidential financial data, previously assigned confidential CAMEL ratings, information gathered during discussions with management, and so forth. Since much of this information is considered in the assignment of the management component of the CAMEL rating, this variable (MGT_RAT) makes a convenient summary measure of regulatory interpretations of private information. We include the variable in our test by measuring it from the bank examination on record as of four quarters before the institutions were downgraded.

[14] As mentioned above, the control sample of healthy banks was also selected from the universe of CAMEL-rated banks and thrifts that were publicly traded over the 1988–1995 period. To be eligible for inclusion in the control sample, these institutions had to have a 1 or 2 CAMEL rating for two consecutive years and had to maintain that rating at their first on-site examination after the two consecutive years were completed. When these criteria were satisfied, the control sample selected contained 151 institutions.

Table 3

Definition of Variables, Means, and Standard Deviations

		CAMEL 3-Rated		CAMEL 4/5-Rated		Control Sample	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Dependent Variable							
CAMELCAT	Dummy variable equal to "1" if the institution experienced a CAMEL rating downgrade to a 3 or a 4 or 5, and "0" otherwise.	1.00	0.00	1.00	0.00	0.00	0.00
Control Variables							
BK_SIZE	Dummy variable equal to "1" if the institution was over $1 billion, and "0" otherwise.	0.21	0.41	0.24	0.43	0.13	0.33
STATE	Percentage change in quarterly residential housing permits by state	–19.52	20.86	–25.57	15.59	–2.76	18.22
Regulatory Variable							
MGT_RAT	Component rating for quality of bank management.	2.02	0.38	2.43	0.67	1.73	0.52
Financial Variables							
EQ_ASSET	Equity capital divided by total assets (%).	10.11	10.06	8.09	2.78	10.71	4.40
NC_ASSET	Noncurrent (delinquent) assets less loan-loss reserves, divided by total assets (%).	1.79	1.27	2.77	2.03	0.59	0.93
RES_ASSET	Reserves for loan losses divided by total assets.	0.76	0.49	1.04	0.70	0.61	0.46
LPROV_ASSET	Loan-loss provisions divided by total assets.	0.31	0.40	0.59	0.80	0.10	0.21
ROA	Quarterly annualized earnings divided by total assets (%).	0.52	1.33	0.03	1.69	1.02	0.56
SEC_ASSET	Securities divided by total assets (%).	17.04	13.80	14.59	12.71	26.52	14.14
VOL_ASSET	Volatile liabilities divided by total assets (%).	21.47	10.73	21.46	11.00	13.42	11.23
Market Variables							
EXPRC	Log of the ratio of the stock price divided by the S&P bank-stock industry index.	–2.76	0.68	–3.02	0.82	–2.35	0.83
EXRET	Market excess or abnormal return, calculated as the difference between the cumulative quarterly return of each stock and the cumulative quarterly return of the CRSP value-weighted index.	–0.04	0.17	–0.11	0.20	–0.02	0.20
COEFVAR	Coefficient of variation is equal to the standard deviation of the stock price for the quarter divided by the average quarterly stock price (%).	6.09	4.18	8.50	8.35	6.08	4.36
BKEQ_MEQ	Book equity divided by market capitalization.	1.41	0.89	1.91	2.45	0.91	1.12
TURNOVER	Number of shares traded in a quarter divided by the number of shares outstanding at the end of the quarter (%).	12.50	11.58	13.35	12.64	11.98	16.43
Number of observations		84		110		151	

The first accounting-related variable in the model, the equity-to-assets ratio (EQ_ASSET), measures the ability of a firm to absorb loan losses before bankruptcy and is expected to be negatively related to the likelihood of future distress. The credit quality of the loan portfolio is captured by three variables: the level of delinquent or noncurrent assets less loan-loss reserves relative to total assets (NC_ASSET), the level of loan-loss reserves to total assets (RES_ASSET), and the quarterly amount of loan provisions to total assets (LPROV_ASSET). The bank reserve variable is expected to be negatively related to the likelihood of a rating downgrade, whereas the noncurrent asset and quarterly loan provision variables are expected to be positively related. Profitability is measured by the return-on-assets variable (ROA), which is expected to be negatively related to future downgrades. Two measures of liquidity are the securities-to-assets ratio (SEC_ASSET) and the volatile-liabilities to assets ratio (VOL_ASSET). The SEC_ASSET variable is expected to be negatively related to future distress, reflecting the fact that higher levels of securities to assets provide sources of additional liquidity in troubled times. A positive sign is expected for the volatile-liabilities ratio (VOL_ASSET), reflecting the notion that higher levels of volatile liabilities reflect expensive and/or potentially risky funding strategies.

Market prices and returns are our primary market variables. Stock price (EXPRC), measured as the natural logarithm of the ratio of the average quarterly price divided by the S&P bank-stock industry index, is expected to be negatively related to rating downgrades. Market excess returns are captured by EXRET, which measures the CRSP value-weighted excess quarterly returns for each observation (and is discussed above in the univariate analysis). Given the high degree of negative excess-return persistence observed above, we expect EXRET to have at least some predictive content and be negatively related to the future downgrades.

Several market variables reflect risk, as in the market model of Fama and French (1993) or the option model of Merton (1974). Price volatility is captured by the coefficient of variation in equity prices (COEFVAR) and is expected to be positively related to downgrades. The book-equity to market-equity ratio (BKEQ_MEQ) provides a second measure of the market's valuation of the firm and is expected to have a positive coefficient because the ratio moves inversely with changes in an institution's stock prices. A trading activity variable, TURNOVER, which measures stock turnover on a quarterly basis, is expected to be positively related to rating downgrades.

The following equation shows the basic logit estimation equation:

$$Camel_{it} = \alpha_i + \sum_{j=1}^{2} \beta_j \left(Control\ Variables_{ijt} \right) + \sum_{j=3}^{3} \beta_j \left(Regulatory\ Variables_{ijt} \right) + \sum_{j=4}^{10} \beta_j \left(Financial\ Variables_{ijt} \right) + \sum_{j=11}^{15} \beta_j \left(Market\ Variables_{ijt} \right) + \varepsilon_{it}$$

The regression results are presented in table 4. Panel A shows the results for firms that were downgraded to 3, and panel B shows the results for firms that were downgraded to 4 or 5. Five models are specified to test the downgrade-predictive value of publicly available as opposed to confidential supervisory information. In particular, specifications 1–3 focus on publicly available information in bank quarterly reports and stock market data, whereas specifications 4–5 add confidential supervisory management ratings to the publicly available information used in models 1–3.

Specification 1 displays a traditional model of bank financial distress, based on publicly available financial data. The model contains two control variables, bank size (BK_SIZE) and geographic location (STATE), although the size variable is generally not statistically significant. Following the two control variables are seven financial ratios, most of which perform as expected. The

Table 4

Logit Regression Results: Four Quarters before Downgrade

Independent Variable	Anticipated Sign	A. CAMEL 3-Rated Group Specification					B. CAMEL 4/5-Rated Group Specification				
		1	2	3	4	5	1	2	3	4	5
Intercept		–0.86 (1.23)	–3.39 (5.00)***	–2.13 (2.07)**	–3.76 (2.71)***	–4.46 2.95 ***	0.90 (0.83)	–5.63 (5.98)***	–1.09 (0.69)	–5.82 (2.96)***	–7.58 (3.12)***
Control Variables											
BK_SIZE	–	0.09 (0.16)	0.82 (1.83)	0.21 (0.36)	0.12 (0.21)	0.21 (0.34)	–0.46 (0.69)	1.38 (2.86)***	–0.52 (0.66)	0.34 (0.43)	0.12 (0.13)
STATE	–	–0.03 (2.97)***	–0.05 (5.06)***	–0.03 (2.72)***	–0.03 (3.05)***	–0.03 (2.80)***	–0.07 (4.50)***	–0.09 (6.93)***	–0.07 (4.17)***	–0.11 (4.29)***	–0.13 (3.91)***
Regulatory Variable											
MGT_RAT	+				1.33 (2.46)**	1.23 (2.18)**				3.26 (4.34)***	3.41 (3.96)***
Financial Variables											
EQ_ASSET	–	–0.02 (1.04)		–0.04 (1.54)	–0.01 (0.25)	–0.02 (0.68)	–0.42 (3.30)***		–0.51 (3.26)***	–0.48 (3.08)***	–0.61 (–3.04)***
NC_ASSET	+	0.88 (3.99)***		0.83 (3.63)***	0.82 (3.70)***	0.77 (3.34)***	1.22 (4.44)***		1.17 (4.17)***	1.13 (3.87)***	1.11 (3.52)***
RES_ASSET	–	–1.19 (1.81)*		–1.24 (1.80)*	–0.91 (1.36)	–0.94 (1.35)	–0.71 (1.23)		–0.95 (1.56)	–1.08 (2.01)**	–1.31 (2.18)**
LPROV_ASSET	+	2.78 (2.37)**		2.89 (2.34)**	2.67 (2.28)**	2.78 (2.29)**	4.29 (3.48)***		4.63 (3.43)***	5.87 (3.79)***	6.61 (3.63)***
ROA	–	–0.83 (2.40)**		–0.65 (1.96)**	–0.75 (2.20)**	–0.61 (1.84)*	–1.29 (2.59)***		–0.86 (1.43)	–1.09 (1.76)*	–0.68 (0.92)
SEC_ASSET	–	–0.04 (2.82)***		–0.05 (2.89)***	–0.04 (2.83)***	–0.05 (2.92)***	–0.05 (2.14)**		–0.05 (2.07)**	–0.09 (3.08)***	–0.09 (2.82)***
VOL_ASSET	+	0.07 (4.08)***		0.07 (4.05)***	0.07 (4.00)***	0.07 (4.01)***	0.08 (3.38)***		0.08 (3.08)***	0.09 (2.84)***	0.09 (2.66)***
Market Variables											
EXPRC	–		–0.94 (3.38)***	–0.52 (1.56)		–0.41 (1.23)		–1.34 (3.88)***	–0.95 (2.38)**		–0.78 (1.66)*
EXRET	–		0.25 (0.28)	–0.07 (0.06)		–0.10 (0.09)		–1.17 (1.31)	0.60 (0.45)		0.06 (0.04)
COEFVAR	+		–0.07 (1.50)	–0.04 (0.59)		–0.05 (0.86)		–0.01 (0.22)	–0.05 (1.27)		–0.11 (1.89)*
BKEQ_MEQ	+		0.12 (0.72)	0.25 (1.29)		0.26 (1.28)		0.03 (0.18)	0.39 (0.98)		0.45 (0.87)
TURNOVER	+		0.00 (0.11)	0.01 (0.43)		–0.01 (0.35)		0.01 (0.54)	0.00 (0.18)		0.02 (0.73)
AIC		194.50	261.36	197.50	189.50	194.07	128.11	224.75	126.32	95.03	97.86
R^2		0.43	0.23	0.45	0.45	0.46	0.61	0.43	0.63	0.66	0.67
χ^2 (relative to specification 1)				7.00	7.00 ***				11.79 **	35.08 ***	
χ^2 (relative to specification 4)						5.43					7.16
degrees of freedom				5	1	5			5	1	5

Note: This table performs logit regression analysis on the sample of commercial banks and thrift institutions. All independent variables are defined in table 3. T-statistics are shown in parentheses below their corresponding regression coefficients. A single, double, or triple "*" indicates significance at the 10%, 5%, or 1% level, respectively.

equity-to-asset ratio (EQ_ASSET) has a negative sign as expected for both groups, thereby confirming the importance of equity levels in models predicting distressed CAMEL ratings. The first asset-quality variable, NC_ASSET, is highly significant at the 1 percent level for all specifications for both groups, showing a direct link between the level of loan delinquency and the likelihood of obtaining a rating downgrade as expected. Another asset-quality variable, RES_ASSET, has the expected negative sign, but it is significant in only four of the eight specifications that use this variable. A third asset-quality variable, LPROV_ASSET, has its expected sign and is significant at the 1 percent level for all relevant specifications. The return-on-asset variable (ROA) also exhibits a negative sign as expected and is generally significant for both groups. The two liquidity measures (SEC_ASSET and VOL_ASSET) also perform as expected. Since almost all the coefficients in specification 1 have their expected signs and are significant at the 1 percent level, this specification provides a good benchmark for assessing the marginal or incremental value of information in market-based variables or in confidential supervisory data.

Specification 2 displays a model with only publicly available market variables. Five market variables are specified: the excess price (EXPRC), a measure of abnormal returns (EXRET), price volatility (COEFVAR), the book-equity to market-equity ratio (BKEQ_MEQ), and the turnover ratio (TURNOVER). The results show that of the five market variables for the two downgraded groups, only the EXPRC variable is statistically significant at the 1 percent level for both the 3-rated group and the 4/5-rated group. None of the other market variables appears to be a good predictor of the downgrades. The comparison of the first two models shows that the model using only market variables, specification 2, performs poorly in comparison with the basic CAMEL prediction model using only quarterly accounting data, specification 1.

The analysis proceeds with specification 3, where market variables are added to the benchmark regression of specification 1 to form a combined model to determine if the market data add significantly to the predictive ability of the model. In addition to identifying the significance of variable coefficients and t-tests, we are able to compare the models through the Akaike information criterion (AIC) and the likelihood-ratio-test statistic. If the AIC variable is lower and the likelihood-ratio-test statistic is positive and statistically significant from a comparison of 3 to 1, we may conclude that a model based on public information combining quarterly and market-based data has higher explanatory power than the benchmark model in specification 1. The results for the combined model show that although only one of the market variables in the regression is significant, the overall model reveals a marginal improvement over specification 1 for the 4- and 5-rated group but no higher explanatory power for the 3-rated group. For the 4- and 5-rated group only, the AIC variable is lower, and its log likelihood test is significant at the 5 percent level. This result highlights the fact the 4/5-rated group presents a more extreme case of financial distress when compared with the 1- and 2-rated control group than does the relatively healthier 3-rated group.

Specification 4 contains financial variables similar to those of the other specifications as well as an additional confidential supervisory variable that captures the past component management rating (MGT_RAT) of the institution. Thus the model reflects a mixture of both public and private information. The supervisory variable (MGT_RAT) is highly significant for both groups, and this significance reveals that private information held by bank supervisors is important in predicting future downgrades. Furthermore, for specification 4, the AIC variable is lower and the log-likelihood-test ratio is significant at the 1 percent level for both the 3- and 4/5-rated groups, a result that demonstrates improvement over specification 1.

Finally, the last model specification (5) adds market information to the model in specification 4. The results show no significant improvement over specification 4, as reflected in a higher AIC variable and an insignificant likelihood-ratio test.

Table 5 contains in-sample tests of the model for both the 3- and 4/5-rated groups for all five specifications. The critical cutoff probability is 50 percent, which is used to determine how the model performs in identifying which banks or thrifts in the two groups are properly classified as likely to experience future CAMEL rating downgrades.[15] Within the in-sample classification for the 3-rated institutions, the correct downgrade prediction of distressed banks and thrifts is about 73 percent for the combined model with public data (specification 3), which is the same level as specification 1. Specification 2, with only stock market data, falls off to only 54 percent in correct downgrade predictions.

Generally the classifications for the 4/5-rated group improve over those for the 3-rated group; and for the 4/5-rated group, specification 3 improves over specification 1. When specification 4 is compared with specification 1, the addition of confidential supervisory information increases the correct downgrade prediction to 95 percent or at the same level as specification 3. Adding stock market data in specification 5 yields the largest correct downgrade classifications, at 96 percent.[16] In terms of absolute numbers, the net change in forecast accuracy increases from 61 to

[15] The "critical probability" refers to the cutoff level, which determines which institutions fall into the predicted downgrade group and which do not. The logistic regression equation calculates a probability for each observation. The institutions whose calculated probability is 50 percent or more are considered likely to be downgraded and are placed into the "predicted downgrade" category.

[16] An out-of-sample test was not conducted because of the limited number of observations for the sample groups. An out-of-sample test requires a "holdout" sample of 20 to 30 percent of the original observations. Holding out that many observations would have significantly reduced the size of the sample available for the analysis.

Table 5

CAMEL Prediction Accuracy and Error Analysis: Four Quarters before Downgrade

Model Specification In-Sample Classification	D–Pred (D) (Correct D)		D–Pred (ND) (Type 1 Error)		ND–Pred (ND) (Correct ND)		ND–Pred (D) (Type 2 Error)	
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
A. CAMEL 3-Rated Group								
1	72.62	61	27.38	23	90.73	137	9.27	14
2	53.57	45	46.43	39	89.40	135	10.60	16
3	72.62	61	27.38	23	91.39	138	8.61	13
4	71.43	60	28.57	24	90.73	137	9.27	14
5	73.81	62	26.19	22	91.39	138	8.61	13
B. CAMEL 4/5-Rated Group								
1	92.73	102	7.27	8	94.04	142	5.96	9
2	73.64	81	26.36	29	88.74	134	11.26	17
3	95.45	105	4.55	5	94.04	142	5.96	9
4	95.45	105	4.55	5	94.70	143	5.30	8
5	96.36	106	3.64	4	95.36	144	4.64	7

Note: The critical value for classification of downgrades is 50 percent.

only 62 institutions in the 3-rated group, an increase that is not significant. However, for the 4/5-rated group the change goes from 102 to 106 institutions as we move from specification 1 to specification 5. Thus, the in-sample classifications for the more distressed group show some incremental increase in correct downgrade predictions when stock market variables are added to the model.

Conclusion

This article explores the notion that publicly available stock price, return, and other market-related variables can provide timely information about bank and thrift financial condition; the article also determines whether such information can be used to improve the predictive accuracy of traditional off-site monitoring models for the purpose of anticipating changes in the CAMEL ratings assigned by regulators. A sample of banks and thrifts that were downgraded to the CAMEL 3, 4, or 5 level between the years 1988 and 1995 was used in the analysis and was compared with a sample of 1- or 2-rated healthy institutions. The first part of the analysis—extensive univariate analysis—confirms the existence of timely information: relatively simple measures of stock price and returns exhibit downward trends as much as two years before banks and thrifts experience rating downgrades, while overall return volatility increases. However, no simple relationship appears in univariate comparisons of several other market variables, including average trading volume and average quarterly turnover of shares.

The second part of the analysis tests whether adding market information to models containing quarterly financial data incrementally improves the ability of the model to predict commercial bank and thrift CAMEL rating downgrades. Specifically, equity market variables such as stock price, returns, price volatility, market valuation, trading volume, and share turnover are combined in a binomial logistic model containing traditional default-prediction variables for the purpose of identifying distressed institutions. The results show that even though for the univariate analysis the market variables appeared to provide timely information before bank and thrift downgrades, in the regression model market information provided only marginal improvements when combined with quarterly financial data. Specifically, the stock market variables improved the fit of the regression model as well as the in-sample predictive content of traditional accounting-based models only for the most distressed institutions—the CAMEL 4- and 5-rated banks and thrifts. No similar evidence was found for the healthier 3-rated firms.

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